CONSTRUCTIVE ALIGNMENT:
REFLECTIONS ON IMPLEMENTATION

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ABSTRACT

Higher Education institutions are increasingly paying close attention to the alignment between curriculum outcomes and assessment strategies. Both university curricula and student assessment are increasingly being defined and driven by learning outcomes. At the same time, information systems have become a fundamental and essential part in supporting learning and assessment. In particular, a great deal of interest has been expressed in intranet-hosted learning environments to support the educational experience. Most commercial learning environments use either modules of study or assessment submissions as the fundamental unit of construction. This results in a failure to record performance by individual learning outcome. There is therefore a mismatch between current educational thinking and the information systems that support the processes.

This paper presents the findings of a pilot project whereby a philosophical shift in Faculty assessment and delivery procedures was achieved through constructive alignment.

Keywords

Constructive alignment, Learning Outcomes, Assessment, Virtual Learning Environment, Higher Education.

1. INTRODUCTION

Information Systems are all pervasive in supporting the educational experience in current Higher Education (HE) provision [4]. Such systems exist to support or deliver functions as diverse as student record keeping, financial management, library and other learning resources, timetabling, communications and the archiving of regulations and course validation documents. This paper is concerned with the areas of curriculum delivery and assessment, and in particular how the introduction of a proprietary Information System was used as a facilitator of change to enable adoption of a constructively aligned curriculum. Interest in this area has come from various sources:

- a general desire to find novel and improved ways to present material and therefore facilitate the learning process;
- a belief that computer-supported delivery provides a better model of learning and assessment;
- a desire to establish modes of study which require reduced staff involvement and greater student independence;
- a desire to introduce effective and efficient methods of assessment e.g. on-line tests and feedback;
- a desire to encourage fundamentally different modes of study e.g. distance learning.

The project had a number of key facets: the rewriting of curriculum documentation particularly learning outcomes; the redesign of assessment procedures; the building of a virtual learning environment that utilises learning outcomes in framing the delivery model and assessing student performance.

It was recognised that critical to the success of this project was the initial process of re-writing the unit-level learning outcomes such that they presented a clear and transparent mapping to the programme-level outcomes. Further, the assessment criteria for each unit-level outcome needed to be couched in such a way that they acknowledged the subject benchmarks for Computing.

At a very early stage it was agreed that simultaneous adoption across all levels would be impractical. However, it was widely held that the unilateral adoption of the criterion referenced

system for all Level One units in the Faculty must be achieved so that the student experience would be consistent across all units. It was therefore proposed that the approach would roll out across subsequent levels as the cohort progressed.

At that time the curriculum taught within the Faculty was thematically structured, and the task of rewriting learning outcome statements and generating criterion reference grids was devolved in the first instance to the unit co-ordinator, and subsequently confirmed and augmented by input from a designated theme development team. It was hoped that this would engender a collegiate acceptance and belief in the framework.

To ensure student coverage of learning outcomes, a fundamental shift in the assessment approach was undertaken to eliminate the "averaging" of performance across elements within a unit. The traditional approach of aggregating performance in assessments in this way masks the performance in individual unit outcomes thereby removing the certainty that competence in particular outcomes has actually been evidenced. This novel approach was at odds with the existing University regulatory framework. It required not only special dispensation to depart from the existing regulations but also a number of interventions with the existing student management system to facilitate the new approach.

2. HE DELIVERY MECHANISMS

The interest described above has led to the development of a number of computer-based learning environments, either generalised or specialised in nature. The Joint Information Systems Committee [5] identifies a number of components for a virtual learning environment. These are:

- mapping of the curriculum into elements (or 'chunks') that can be assessed and recorded;
- tracking of student activity and achievement against these elements;
- support of online learning, including access to learning resources, assessment and guidance;
- online tutor support;
- peer group support;
- general communications, including email, group discussion and web access;
- links to other systems, both in-house and externally.

A move to a novel delivery mechanism requires careful deliberation [3]. In creating a structure for delivery of learning and assessment material, key decisions must be taken. One of the most important of these is to establish the unit of packaging. Typically, HE institutions have adopted one of the following models:

- Individual staff web pages containing unit material for which they have responsibility;
- A hierarchical structure of course, module/unit.

Selecting a delivery mechanism that centres on staff web pages offers maximum flexibility in the way that delivery is structured and material is presented. However it creates an unnecessarily strong coupling between the staff member co-ordinating the unit and the material, which can be particularly unhelpful where distance learning or remote delivery is involved. In addition it invariably makes no structured contribution to the assessment of students. Furthermore, key contributors, such as statements of outcomes to be assessed, are often presented, or even maintained, locally. This can give rise to inaccuracies and inconsistencies.

A delivery approach that is unit-based offers greater consistency and provides a more intuitive access point to materials. Under such systems, units can often be disaggregated into a package that is smaller than that which comprises a published "module of study" offering further flexibility. This approach also offers the possibility of a coherent assessment mechanism were a student profile of performance in on-line tests etc. can be maintained. The unit-based philosophy provides the foundation for many off-the-shelf learning environments.

3. ASSESSMENT BY UNIT LEVEL LEARNING OUTCOMES

A significant limitation of many unit-based approaches is that despite the possibility of addressing granularity of packaging, they do not necessarily ensure coverage of learning outcomes. Where these systems are employed there is an underlying assumption that through careful design of assessments, learning outcome coverage will inevitably take place. Clearly this is not necessarily the case.

Learning outcomes are bestowed with great importance in current educational thinking [7]. Courses are normally specified with programme-level outcomes that define the expectation of student achievement on completion of the course, or sometimes at various levels within the course. The units that comprise the course are specified in terms of unit-level outcomes. These define the skills, knowledge and understanding that a student will be able to demonstrate on completion

of the unit. The program level outcomes can be demonstrably achieved through satisfaction that competence in the unit-level outcomes has been proven. It is essential that institutions are able to justify, normally at initial validation of the course, that the collection of units and their associated outcomes do indeed satisfy the programme-level outcomes. In turn, it is expected that the collection of material that forms the assessment diet for the unit satisfies the unit-level outcomes. This is often an annual activity, at least, and usually involves the participation of unit co-ordinators and external examiners. Often, this process is most difficult to audit and without the benefit of unambiguous evidence, it can lead to complex subsequent re-audit and post hoc justification at subject or institutional review.

A learning and assessment methodology that focuses on learning outcomes, particularly by employing a system of grading through criterion referencing, can address these issues. It is also believed by many that a constructive alignment such as this [1] may also have important benefits in the exposition of the curriculum and in removal of obfuscation around assessment processes.

4. THE PILOT PROJECT

A decision was taken by the Faculty of Technology at the University of Lincoln to move to a learning-outcome driven delivery and assessment approach. An intranet-based virtual learning environment was developed to support the new approach. The system, known as the Specialised Learning Environment (SLE) provides the usual collection of services such as bulletin boards and notices, document templates, staff contact details etc., as well as a facility to download assessment material and grading criteria. At the heart of the system the unit-level learning outcomes are stored and uniquely identified. This database drives both the teaching and learning and the assessment strategies within the Faculty.

Each degree award is made up of a number of units of study. The co-ordinator of each unit is responsible for identifying and creating a number of “learning packages” which comprise the expected student learning for a unit. Each learning package assesses a particular set of learning outcomes. Each learning package contains the materials assembled by a member of staff, typically: lecture notes, seminar activities, workshop activities, reading lists, web links etc. A learning package manifests itself as a ‘mini web site’ to present the resources to the student.

Unit co-ordinators also devise the assessment tasks for their unit(s). Each assessment submission, whether an assignment, examination, presentation etc. is encapsulated as an “assessment package” which covers a particular set of learning outcomes. The set of all assessment packages in a unit must cover the totality of unit-level learning outcomes for that unit. This coverage is auditable within the SLE.

For each assessment a criterion referencing grid is drawn up which clearly specifies expected levels of achievement in each learning outcome (appendix 1.2 contains a sample criterion reference grid). These levels of achievement are identified across the standard UK classification grading of fail, 3rd, lower second, upper second and first class performance, acknowledging Bloom’s taxonomy [2]. Reference is made in each cell of the grid to the relevant assessment task that leads to that performance criterion being awarded. The SLE ensures consistency in use of learning outcomes by parsing the criterion specification upon submission by the co-ordinator. The environment also facilitates the entry of student grades against individual outcomes using the grading criteria to establish an appropriate level of achievement. This contrasts with the traditional approach where marks rather than grades are entered against assessment tasks, and component or element marks are aggregated and averaged across the diet of assessment. The difficulty with the traditional approach is that the coverage of individual outcomes, assuming that more than one outcome is covered in a task, is blurred and invariably lost.

The focus on learning outcomes also renders the process of assessment retrieval in the event of failure much more straightforward. Students will be aware, often from an early stage, of a failure to demonstrate competence in a particular outcome. If the assessment has been carefully specified, the retrieval will not require an entire assessment to be repeated but merely the aspect that led to the failed outcome. Retrieval will simply require resubmission of work in that one area. Although this is possible in other systems, the SLE automates this process and provides students on-line support in the process of locating and correcting failure.

5. YEAR ONE - IMPLEMENTATION

During the academic year of the project’s inception, student groups were regularly counselled on the principles underlying the delivery and assessment model, and regular meetings of interest groups were held to reflect upon and inform refinement of the approach.

In the first iteration, some unit tutors found the production of the criterion referencing grids an onerous task, in particular where the assessed component had mathematical content. However,

tutors acknowledged that the effort paid dividends at the point of assessment.

It must also be acknowledged that the decision to adopt these principles across a single level only in the first instance did create divisions within the teaching team – some tutors only delivered units at levels two and three and were not involved in the process of writing criterion reference grids, only in refining and editing the grids of others. This led to some postponement of responsibility in some quarters, and an apparent 'slow start' in developing the skills needed to write criteria and benchmark statements effectively. All tutors felt however, that the process of moderation of grades between lecturers and between delivery centres was simplified as the standards were more clearly specified.

Early feedback from the pilot project was, in the main, positive. It suggested that benefits for students and staff, and improvements in institutional quality, might be obtained from this novel delivery and assessment approach.

Students liked the clarity in assessment grading (as opposed to marking) that was provided by adopting criterion referencing grid for each summative element submitted. They characterised this as an enabling aspect of the assessment process. The expectations of tutors were clearly specified in the criterion reference grid and the scope and level of the task was rendered more comprehensible. They liked the fact that being graded in this way provided much clearer feedback than was often provided under more traditional approaches. It was clear, for example, why they had exceeded the threshold mark or what needed to be done to achieve a higher grade.

External examiners also appreciated this grading system and commented that it was a very positive development for student assessment and for diagnostic feedback.

Unit tutors identified a number of cases of learning packages that supported learning activity across different units. This created an opportunity for the re-use of learning materials, and reinforcing concepts that appeared in different places in the curriculum. It was hoped that as the roll-out of the pilot progressed to all levels, these learning packages would have validity not just in the unit for which they were specifically written, but as refresher packages, or even non-program specific extra-curricula modules for students keen to enhance their understanding of the subject domain.

6. YEAR ONE - EVALUATION

6.1 Action Outcomes

A sample of the student cohort who studied under the pilot scheme was surveyed. The object of the evaluation was to measure the level of engagement with the SLE, and also to gauge the effectiveness of the SLE, particularly in comparison with alternative methods of delivery and assessment. The evaluation took place with level 1 students towards the end of their first semester of study. Questions were framed in three sections: firstly students were asked whether they had used the SLE in a range of activities; secondly they were asked to rank the effectiveness of the SLE in facilitating the activity; thirdly they were asked to compare the SLE with alternative approaches.

The results of the evaluation were most encouraging but also provided the designers of the system with some key areas for improvement.

Student engagement with the SLE was very high. Reassuringly, all students in the sample questioned had used the system to obtain key documents such as the in-course assignment, the accompanying cover sheet and, more importantly, the relevant criterion referencing sheet. High levels of engagement (>85%) were also recorded in obtaining lecture and seminar material and in discovering submission dates and hand-in procedures for assignments. Lower scores were identified for obtaining recommended book lists for units and for locating staff contact details. This may have been due to a duplication of this information by paper-based means during the student induction week.

Student evaluation of the effectiveness of the SLE was encouraging. The students sampled recorded effectiveness ratings of better than average (<3 on a 1-5 Likert scale) in all categories identified. The most effective aspects of the system were identified as downloading assessment briefing and grading criteria, obtaining lecture and seminar material and reading policy documents. The system was observed to be less effective in providing staff contact details, assignment submission procedures and reading lists.

In comparing the SLE with more traditional approaches the students clearly saw benefits in being able to obtain lecture material electronically (89%). Interestingly, the support for provision of seminar activities and material was less pronounced (61%). This could be explained in part by the additional printing costs entailed (the University simultaneously had introduced a more punitive scheme for copy charging!). With reference to the assessment by learning outcomes, students welcomed the provision of a

criterion referencing grid and commented that this helped in assessment preparation and prioritising learning activity. Once again the issue of locating staff contact details was flagged as an area where the SLE performed less well (67%).

6.2 Research Outcomes

The survey findings provided useful feedback for the future management of the system as the pilot is further rolled-out. In particular, the free-text comments proffered on the questionnaires indicate a number of areas for improvement in the system. These were primarily concerned with interface design issues: ease of navigation, content hierarchy and window resizing. Download times were also cited as a problem in some cases.

The evaluation carried out so far has been focused on induction and in-course support for learning and assessment. The next stage will be to investigate the results of the summative assessment process. The project team believe that student performance and progression rates will be enhanced, particularly where the entire assessment cycle, including retrieval and reassessment, is considered.

It is also proposed that the effectiveness of this learning environment be established in a more rigorous way. Preliminary discussions have taken place to employ an instrument called the Learning Effectiveness Survey [6] which adopts a perception-based approach to measuring the effectiveness of learning interventions.

The decision to centre on learning outcomes as a core driver highlighted a number of potential benefits:

- In developing assessment material, academics are required to demonstrate how the tasks cover the learning outcomes of the unit. A learning environment that focuses on learning outcomes rather than unit or sub-unit as a level of granularity can ensure that assessment tasks do meet the demands of the learning outcomes.
- In focussing on learning outcomes, students can have clarity about the expectations of a unit of study and can be confident about having achieved at the expected level. Comparability between standards achieved by students on a programme, and between different institutions offering that programme, can be ensured.
- In assessing students, staff can adopt a grading system whereby a set of criteria can be set against each outcome. Achievement at each grading level can be carried out with more confidence and, arguably, more easily than by utilising tradition numerical marking schemes.
- Retrieval for a student in the case of unit failure can be much more precise. Resit tasks can be set that address the individual outcomes rather than requiring a complete resubmission of an assessment task.

However, a move towards a learning outcome driven approach can provide a number of challenges:

- Many off-the-shelf packages provide an assessment engine that scores numerically and averages marks across assessments. This can subvert attempts to record success or failure by outcome where individual outcomes must be passed.
- Many programmes have evolved over time with the learning outcomes sometimes lagging in the round of annual routine maintenance. For many programmes, a thorough review of learning outcomes is required to ensure that currency, contemporaneousness, granularity are at the level required.
- If student success is measured by threshold achievement in all learning outcomes in a unit, then a unit failure rate, at first sitting, may increase. This is due to the removal of the averaging effect across assessments in traditional systems of marking. Adopting a learning outcome driven approach requires a leap of faith; although many students will miss out on one or two outcomes in a unit, the method of retrieval is more straightforward (i.e. resubmitting only the failed aspect) and the guidance and support in making good the failure is clearer and more direct.

7. CHALLENGES TO THE APPROACH

At the conclusion of the first delivery and assessment cycle of the pilot project a number of challenges for an effective repetition and wider roll-out of the learning outcome driven approach were emerging.

7.1 Learning Environment Support

The approach is heavily dependent on the support provided by the tailored learning environment. A locally devised software support system is always dependent on the availability of local maintenance and technical back-up. A proposed restructuring of staffing at the institution is threatening the continuing support for the system and could undermine the approach. The lack of a suitable off-the-shelf solution is a significant problem here.

7.2 Institutional Drivers

The Faculty gained institutional support to employ local variations to the assessment regulations in order to adopt the pilot approach. In summary, this overrode the normal averaging of student performance across submission elements in a unit of study to allow for discrete assessment in individual learning outcomes. A subsequent change to university regulations has resulted in the requirement to record performance at the submission element level; this requires averaging across learning outcomes within the element. This regulation change could have significant impact on the principle of assessment by learning outcome, especially in those units where the assessment strategy had included multiple opportunities for a student to demonstrate a competence in a particular outcome. The likely impact of this may be a move toward more monolithic assessment submissions where the whole assessment of a particular outcome happens in one submission only.

In addition, changes to the structure of the academic year have resulted in a shift towards year-long rather than semester-long units. Although this in itself does not preclude a learning outcome driven approach, when coupled with the assessment regulation changes outlined above it increases the size of assessment block under consideration and tends to invite further aggregation and averaging across outcomes.

7.3 Staff Buy-in

In order to achieve full acceptance and understanding by the student body, the new assessment approach requires consistency in implementation from the staff team. Where a number of tutors are unconvinced by the new approach there is the potential for it to be undermined. An example of the difficulty in achieving full acceptance can be seen in those tutors more disposed to assess through tests and examinations; this is particularly characterised in numerate disciplines.

8. CONCLUSIONS

Early feedback from the pilot project has been, in the main, positive. Students liked the clarity provided by the criterion referencing grid (see appendix 1.1). They characterised this as an enabling aspect of the assessment process. The expectations of tutors were clearly specified and the scope of the task was rendered more comprehensible. They liked the fact that being graded in this way provided much clearer feedback than was often provided under more traditional approaches. It was clear, for example, why they had exceeded the threshold mark or what needed to be done to achieve a higher grade.

External examiners appreciated the aspects mentioned above and thought this to be a very positive development for student assessment and for diagnostic feedback. They did raise some concerns about the granularity of the unit-level learning outcomes. It was possible that by specifying too many detailed outcomes in a unit, a student was effectively being given multiple opportunities to fail. In a subsequent review, the team amended the learning outcome set, for example by removing redundant outcomes, where a more trivial outcome was subsumed by another more detailed one.

Staff identified a number of cases of learning packages that supported learning activity across different units. This created an opportunity for the re-use of learning materials, and reinforcing concepts that appeared in different places in the curriculum.

Staff found the production of the criterion referencing grids an onerous task, but one that paid dividends at the point of assessment. Staff echoed the comments about consistency and comprehensibility. They felt that the process of moderation of grading between lecturers and between centres was simplified as the standards were more clearly specified. In terms of data entry, the learning environment provided an interface that mimicked the criterion grid. For each student, the member of staff could simply click on the cell of the grid that reflected student achievement in an assignment. Overall performance in a unit was established by assigning a nominal value to each performance classification. A weighted average of marks obtained in each outcome could then be derived. Although this might appear to run counter to the spirit of outcome-base assessment, the Institution required a traditional marking approach in deriving overall unit performance in order to derive the overall degree classification. Success of the pilot project might see the roll-out of the new approach institution-wide, rendering the mapping from grade to mark unnecessary.

As the project rolls forward into subsequent iterations the authors are better placed to promote areas of good practice and also to reflect on potential problems that may hinder others following this approach. In particular three key critical success factors have been identified:

- the software support particularly where the system acts partly as agent of change and partly as delivery vehicle;
- the institutional context as manifested by collegiate support and regulatory matters;
- the staff buy-in to the system.

9. REFERENCES

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APPENDIX

1.1 Typical Criterion Reference Grid

AP10058 CMC082 Operating Systems Tools

Learning outcome	Criterion	A1	A2	Fail	3	2ii	2i	1
Classify operating system tools by area of application	Evidence provided of a knowledge of a range of tools and ability to cite appropriate situations for their use	*	*	Less than two tools evidenced	Tools evidenced but no attempt made to explain the relevance of their application context	A range of tools discussed and a basic attempt made to explain the relevance of their application context	A wide range of tools discussed with the application context of these and other tools explained	A wide range of tools evaluated with thorough explanation of the application context of these and other tools
Use a range of operating systems tools to automate tasks	Design and implement a software solution to a given problem which employs operating systems tools	*	*	Failure to meet the minimum specification for the problem	Basic solution implemented	Basic solution implemented with attempt made to document code.	Basic solution plus further submission which includes implementation of more advanced features. Design, source code and testing strategies are well documented	Basic solution plus further submission which is complete in all aspects. Thorough documentation in all respects.
Select and utilise operating system tools to manipulate text files	Extract horizontal and vertical subsets of data held in text files, sort text files and produce reports to a given specification	*		Failure to use tools to extract data from text files as requested	Ability demonstrated in reducing data sets through employing tools	Evidence of ability to perform a range of criteria specified	Evidence of ability to perform the criteria specified	Evidence of ability to perform the criteria specified. Thorough approach adopted in all respects
Select an appropriate set of operating system tools to solve problems	Justify the selection of a range of tools used in solving problems	*	*	Less than two tools employed	Tools employed but no clear attempt made to justify their selection	A range of tools employed and a basic attempt made to justify their selection	A wide range of tools employed in both a basic and an advanced submission with good attempt at justifying selection and a discussion which includes other tools as well	A wide range of tools evaluated in both a basic and an advanced submission with thorough justification of selection
Simulate a multi-processing scenario by using operating system tools	Use either fork or handles to create multiple processes and execute the processes concurrently		*	Failure to meet the minimum specification for the problem	Basic multiprocessing solution implemented.	Basic multiprocessing solution implemented with attempt made to document code.	Basic multiprocessing solution plus further submission which includes implementation of more advanced features. Design, source code and testing strategies are well documented	Basic solution plus further submission which is complete in all aspects. Attention given to problems particular to multiprocessing environments. Thorough documentation in all respects.